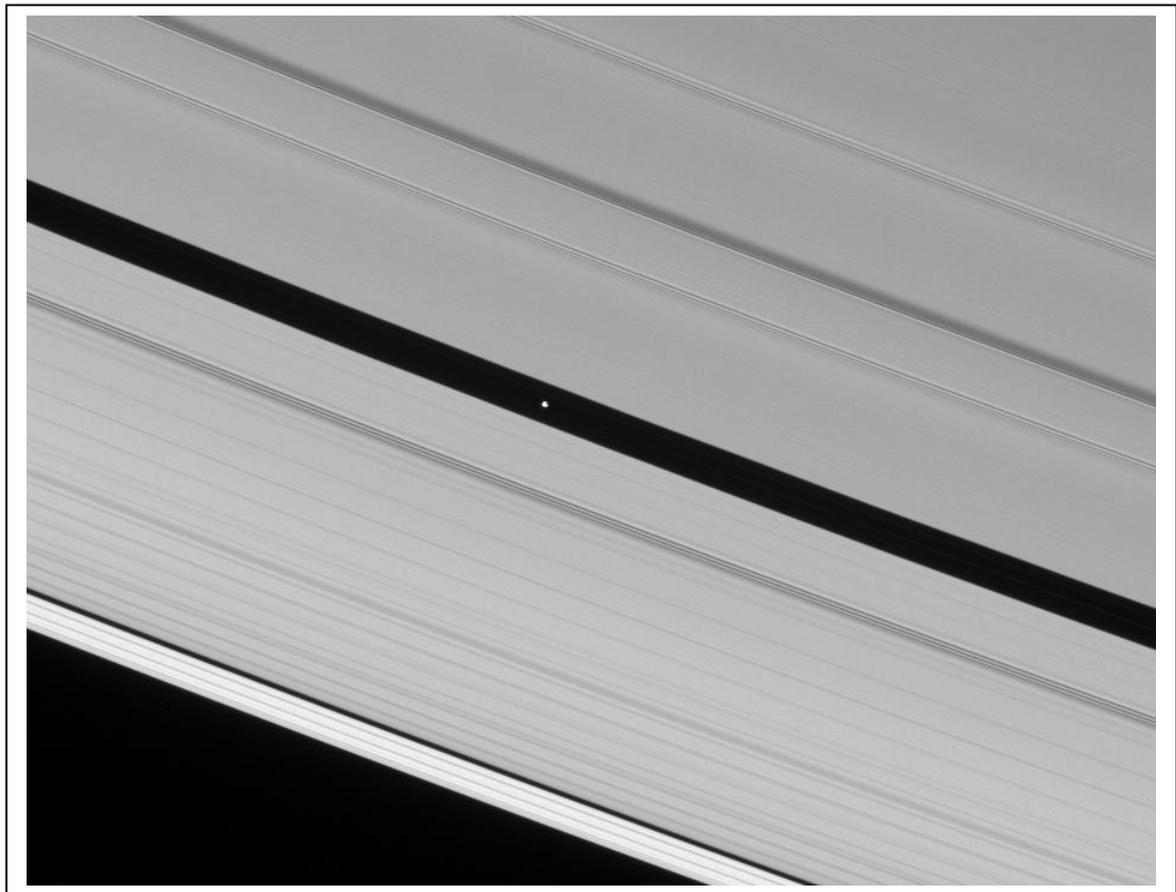


The Encke Gap is a prominent feature of Saturn's outer A-ring system that has been observed since the 1830's. The arrival of the Cassini spacecraft in July 2004 revealed the cause for this gap. A small moonlet called Pan clears out the ring debris in this region every 12 hours as it orbits Saturn!

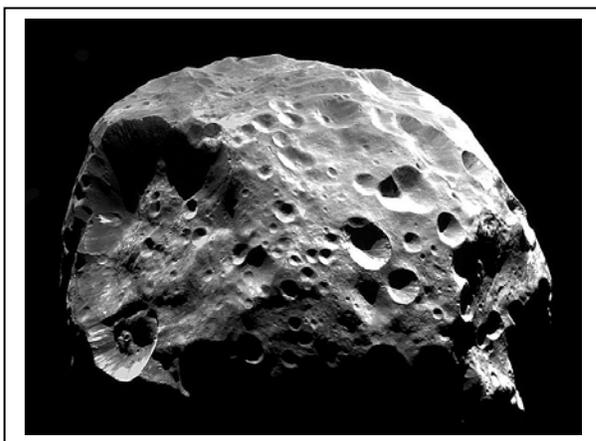
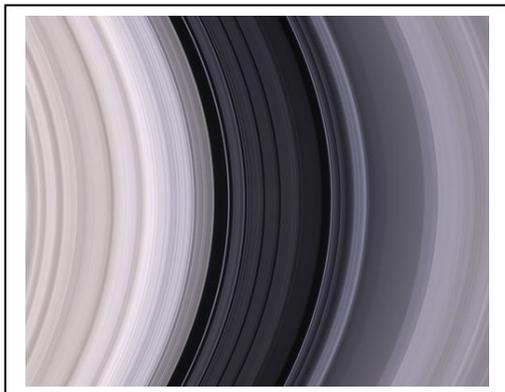


Problem 1 - This image was taken by Cassini in 2007 and at the satellite's distance of 1 million kilometers, spans a field of view of 5,700 km x 4,400 km. With the help of a millimeter ruler, what is the scale of the image in kilometers per millimeter?

Problem 2 - Pan is that bright spot within the black zone of the Encke Gap. About how many kilometers in diameter is Pan?

Problem 3 - About how wide is the Encke Gap?

Problem 4 - About what is the smallest feature you can discern in the photo?



Problem 1 - The width of the picture is 150 millimeters, so the scale is $5,700 \text{ km}/150 \text{ mm} = \mathbf{38 \text{ km/mm}}$.

Problem 2 - Pan is about 1.0 millimeters in diameter which is $38 \text{ km/mm} \times 1 \text{ mm} = \mathbf{38 \text{ kilometers in diameter}}$.

Problem 3 - Students should measure a width of about 5.0 millimeters which is $38 \text{ km/mm} \times 5.0 \text{ mm} = \mathbf{190 \text{ kilometers}}$. The actual width of the Encke Gap is 325 km, but projection effects will foreshorten the gap as it appears in the photo. With the actual gap width (325 km) as the hypotenuse, and 190 km as the short side, the angle opposite the short side is the viewing angle of the camera relative to the ring plane. This angle can be found by constructing a scaled triangle and using a protractor to measure the angle, which will be about 36 degrees.

Problem 4 -

It is difficult to estimate lengths smaller than a millimeter. Students may consider using a photocopying machine to make a more convenient enlargement of the image, then measure the features more accurately. Small dark ring bands are about 0.1 mm wide, which is **about 4 km**.

*NASA/Cassini images, top to bottom:
 Saturn Rings closeup showing Cassini Division and Encke Gap;
 Rings closeup showing detail;
 One of Saturn's outer satellites, Phoebe, is about 200 km across, and may have been a captured comet.*